

WHAT IS CLAIMED IS:

- 1           1. An angioplasty catheter comprising:  
2            a catheter body having a proximal end and a distal end;  
3            a radially expandable shell near the distal end of the catheter body;  
4            an external structure carried over but unattached to the shell; and  
5            an attachment structure having a proximal end and a distal end attached to the  
6 external structure, wherein the attachment structure is sufficiently sized and compliant to  
7 accommodate geometrical changes and reaction forces produced by the external structure as  
8 it is expanded by the shell.
  
- 1           2. A catheter as in claim 1, wherein the external structure comprises a  
2 scoring structure.
  
- 1           3. A catheter as in claim 1, wherein the external structure comprises a  
2 cutting structure.
  
- 1           4. A catheter as in claim 1, wherein at least a portion of the external  
2 structure is arranged helically over the shell.
  
- 1           5. A catheter as in claim 1, wherein the external structure has a proximal  
2 end and a distal end, and wherein the proximal end of the attachment structure is fixed to the  
3 catheter body and the distal end of the attachment structure is secured to the proximal end of  
4 the external structure.
  
- 1           6. A catheter as in claim 5, wherein the distal end of the external structure  
2 is fixed to the catheter body, and wherein the attachment structure axially extends to  
3 accommodate foreshortening of the external structure as the shell is expanded.
  
- 1           7. A catheter as in claim 6, wherein the attachment structure rotationally  
2 extends to accommodate rotation of the external structure as the shell is expanded.
  
- 1           8. A catheter as in claim 7, wherein the attachment structure comprises a  
2 compliance tube having an outer diameter and an inner diameter that extends over the  
3 catheter body.

1                   9.       A catheter as in claim 8, wherein the inner diameter of the compliance  
2 tube is larger than an outer diameter of the catheter body so that the compliance tube freely  
3 extends with respect to the catheter body as the external structure foreshortens.

1                   10.      A catheter as in claim 9, wherein the compliance tube inner diameter is  
2 sized so that the compliance tube freely rotates with respect to the catheter body as the  
3 external structure rotates.

1                   11.      A catheter as in claim 9, wherein the compliance tube is sized to  
2 control the compliance of the external structure and expandible shell.

1                   12.      A catheter as in claim 11, wherein the compliance tube has a wall  
2 thickness ranging from 0.01 in. to 0.1 in.

1                   13.      A catheter as in claim 11, wherein the compliance tube has a length  
2 ranging from 1cm to 10 cm.

1                   14.      A catheter as in claim 9, wherein the material of the compliance tube is  
2 selected to control the compliance of the external structure and expandible shell.

1                   15.      A catheter as in claim 14, wherein the compliance tube comprises an  
2 elastic material.

1                   16.      A catheter as in claim 15, wherein the compliance tube comprises a  
2 polymer selected from the group consisting of nylon or Pebax.

1                   17.      A catheter as in claim 15, wherein the compliance tube comprises a  
2 braided material.

1                   18.      A catheter as in claim 15, wherein the compliance tube comprises a  
2 metal.

1                   19.      A catheter as in claim 18, wherein the compliance tube comprises a  
2 wire mesh.

1                   20.      A catheter as in claim 9, wherein the compliance tube has one or more  
2 perforations to control the compliance of the external structure and expandible shell.

1                   21. A catheter as in claim 20, wherein the one or more perforations  
2 comprise one or more slots extending along the outside circumference of the compliance  
3 tube.

1                   22. A catheter as in claim 21, wherein the slots form a pattern along the  
2 outside circumference of the compliance tube.

1                   23. A catheter as in claim 22, wherein the slots are parallel to each other.

1                   24. A catheter as in claim 22, wherein the slots extend helically across the  
2 compliance tube.

1                   25. A catheter as in claim 22, wherein the slots extend radially across the  
2 compliance tube.

1                   26. A catheter as in claim 22, wherein the slots are circular in shape.

1                   27. A catheter as in claim 22, wherein the slots are rectangular in shape.

1                   28. A catheter as in claim 8, wherein the compliance tube has an outer  
2 diameter that tapers from its distal end to its proximal end.

1                   29. A catheter as in claim 28, wherein the outer diameter of the  
2 compliance tube tapers down from in the range of .04 in. to .010 in. from the distal end and to  
3 the proximal end.

1                   30. A external catheter as in claim 1, wherein the attachment structure is  
2 connected at its distal end to the external structure and at its proximal end to a manipulator.

1                   31. A catheter as in claim 30, wherein the manipulator is positioned at the  
2 proximal end of the catheter body and the attachment structure extends from the external  
3 structure across the length of the catheter body.

1                   32. A catheter as in claim 30, wherein the attachment structure axially  
2 extends to accommodate foreshortening of the external structure as the shell is expanded.

1                   33. A catheter as in claim 32, wherein the attachment structure rotationally  
2 extends to accommodate rotation of the external structure as the shell is expanded.

1               34. A catheter as in claim 33, wherein the attachment structure comprises a  
2 compliance tube having an outer diameter and an inner diameter that extends over the  
3 catheter body.

1               35. A catheter as in claim 34, wherein the inner diameter of the  
2 compliance tube is larger than an outer diameter of the catheter body so that the compliance  
3 tube freely extends and rotates with respect to the catheter body as the external structure  
4 foreshortens.

1               36. A catheter as in claim 35, wherein the compliance tube has a wall  
2 thickness and a length that are sized to control the compliance of the external structure and  
3 expandible shell.

1               37. A catheter as in claim 35, wherein the compliance of the external  
2 structure is controlled by actuating the manipulator during expansion of the radially  
3 expandible shell.

1               38. A catheter as in claim 35, wherein the compliance of the external  
2 structure is controlled by actuating the manipulator during contraction of the radially  
3 expandible shell.

1               39. A catheter as in any of claims 37 or 38, wherein actuating the  
2 manipulator comprises axially advancing the attachment structure with respect to the catheter  
3 body.

1               40. A catheter as in claim 39, wherein axially advancing the attachment  
2 structure comprises pulling the attachment structure away from the distal end of the catheter  
3 body.

1               41. A catheter as in any of claims 37 or 38, wherein actuating the  
2 manipulator comprises rotating the attachment structure with respect to the catheter body.

1               42. A method of dilatating a stenosed region in a blood vessel, the method  
2 comprising:

3               introducing an external structure carried over an expandible shell that is  
4 connected to a catheter body by an attachment structure;

5                   expanding the external structure within a stenosed region within the blood  
6 vessel, wherein the attachment structure axially extends to accommodate foreshortening of  
7 the external structure as the shell is expanded.

1                  43.     A method as in claim 42, wherein the attachment structure rotationally  
2 extends to accommodate rotation of the external structure as the shell is expanded.

1                  44.     A method as in claim 43, wherein the attachment structure comprises a  
2 compliance tube having an outer diameter and an inner diameter that extends over the  
3 catheter body.

1                  45.     A method as in claim 44, wherein the inner diameter of the compliance  
2 tube is larger than an outer diameter of the catheter body so that the compliance tube freely  
3 extends and rotates with respect to the catheter body as the external structure foreshortens.

1                  46.     A method as in claim 44, wherein the compliance tube is sized to  
2 control the compliance of the external structure and expandible shell.

1                  47.     A method as in claim 46, wherein the compliance tube has a wall  
2 thickness ranging from 0.01 in. to 0.1 in.

1                  48.     A method as in claim 46, wherein the compliance tube has a length  
2 ranging from 1cm to 10 cm.

1                  49.     A method as in claim 44, wherein the material of the compliance tube  
2 is selected to control the compliance of the external structure and expandible shell.

1                  50.     A method as in claim 49, wherein the compliance tube comprises an  
2 elastic material.

1                  51.     A method as in claim 50, wherein the compliance tube comprises a  
2 polymer.

1                  52.     A method as in claim 43, wherein the external structure has a proximal  
2 end and a distal end, and wherein the method further comprises the step of fixing the  
3 proximal end of the attachment structure to the catheter body.

1               53. A method as in claim 43, wherein the external structure has a proximal  
2 end and a distal end, and wherein the method further comprises the step of fixing the  
3 proximal end of the attachment structure to a manipulator.

1               54. A method as in claim 53, wherein the manipulator is positioned at the  
2 proximal end of the catheter body and the attachment structure extends from the external  
3 structure across the length of the catheter body.

1               55. A method as in claim 54, wherein the compliance of the external  
2 structure is controlled by actuating the manipulator during expansion of the radially  
3 expandible shell.

1               56. A method as in claim 54, wherein the compliance of the external  
2 structure is controlled by actuating the manipulator during contraction of the radially  
3 expandible shell.

1               57. A method as in any of claims 55 or 56, wherein actuating the  
2 manipulator comprises axially advancing attachment structure with respect to the catheter  
3 body.

1               58. A method as in claim 57, wherein axially advancing attachment  
2 structure comprises pulling the attachment structure away from the distal end of the catheter  
3 body.

1               59. A method as in any of claims 55 or 56, wherein actuating the  
2 manipulator comprises rotating the attachment structure with respect to the catheter body